# Controlling the doubly fed induction generator based wind turbines during normal and disturbed grid voltage

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## Abstract

This work presents an improved strategy in the field of predictive control (PC) of the doubly fed induction generator (DFIG). The proposed strategy applies four voltage vector in every period in order to have constant switching frequency and low current THD. The appropriate voltage vectors in each period are recognized when the estimated duration times of selected active vectors are positive. The suggested techniques has excellent performance during transient and steady-state conditions. The proposed predictive control can easily flow the references under normal and abnormal voltage conditions even if the references contain ac terms. Without any additional controller, the proposed technique could obtain smooth stator active and reactive power or smooth electromagnetic torque or could inject sinusoidal and balance current into the grid when the voltage unbalance appears in the stator winding of DFIG. Moreover, under unbalanced voltage conditions, still four voltage vectors are applied in every switching period. The simulation studies for this technique are carried out for 2 MW DFIG in Matlab Simulink environment under ideal and unbalanced grid voltage. Furthermore, the experimental studies are now conducting. The results of this technique are compared to other strategies. The comparisons show that the performance of the proposed strategy is significantly superior to the other strategies.

## I. Introduction:

The DFIG consists of two converters. The rotor side converter (RSC) control the generator and control the stator active and reactive power. The grid side converter (GSC) regulate the dc link voltage. Schematic of DFIG is shown in Fig. 1. The experimental setup is shown in Fig. 2.

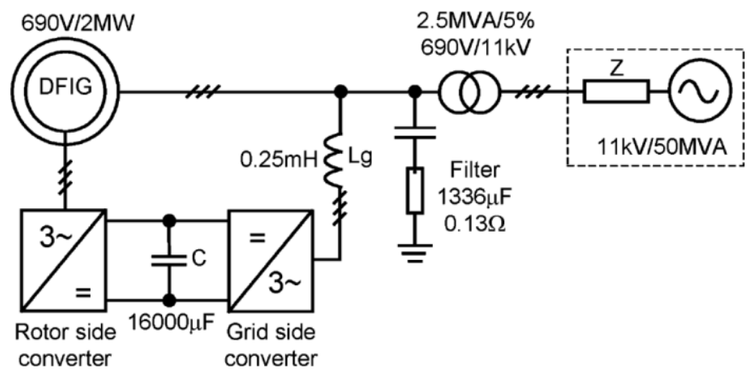


Fig. 1. Simulated DFIG wind turbine

Fig. 2. DFIG wind turbine experimental setup

## II. Proposed Strategy:

In this novel strategy, at each switching period, four voltage vectors are selected to be applied by the rotor side converter of doubly fed induction generator according to a very simple algorithm. Duration time of selected vectors are estimated by two equations. Finally, the appropriate vectors will be employed according to their duration times.

## III. Simulation results:

In order to show the superiority of the proposed PC during unbalanced voltage conditions, a compression study have been conducted between the proposed PC and two previous PC method under the same conditions. three control power targets have been adopted during unbalanced grid voltage which are:

1- smooth active and reactive power (t= 0.4 s to t=0.5 s)

2- smooth electromagnetic torque and reactive power (t= 0.5 s to t=0.6 s)

3- balance stator current (t= 0.6 s to t=0.7 s)

The simulation result for the proposed PC is shown in Fig. 3. the results for previous PC based on three voltage vectors and previous PC based on one voltage vector are illustrated in Figs. 4 and 5, respectively. In the whole study the stator active and reactive power references were set to be -1.5 MW and 0 Mvar, respectively, and the rotor speed was fixed in 0.8 PU. As can be seen, the performance of the proposed strategy is more better than the other two strategies.

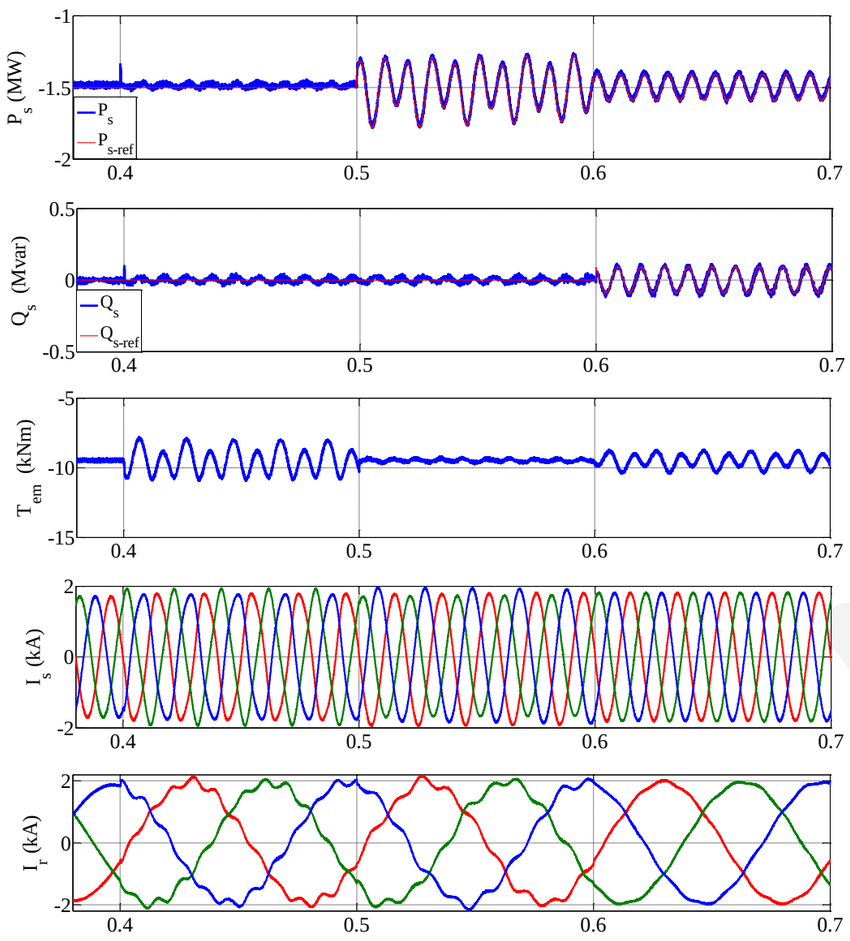


Fig. 3. Result of proposed PC of DFIG during unbalanced grid voltage with three different control targets

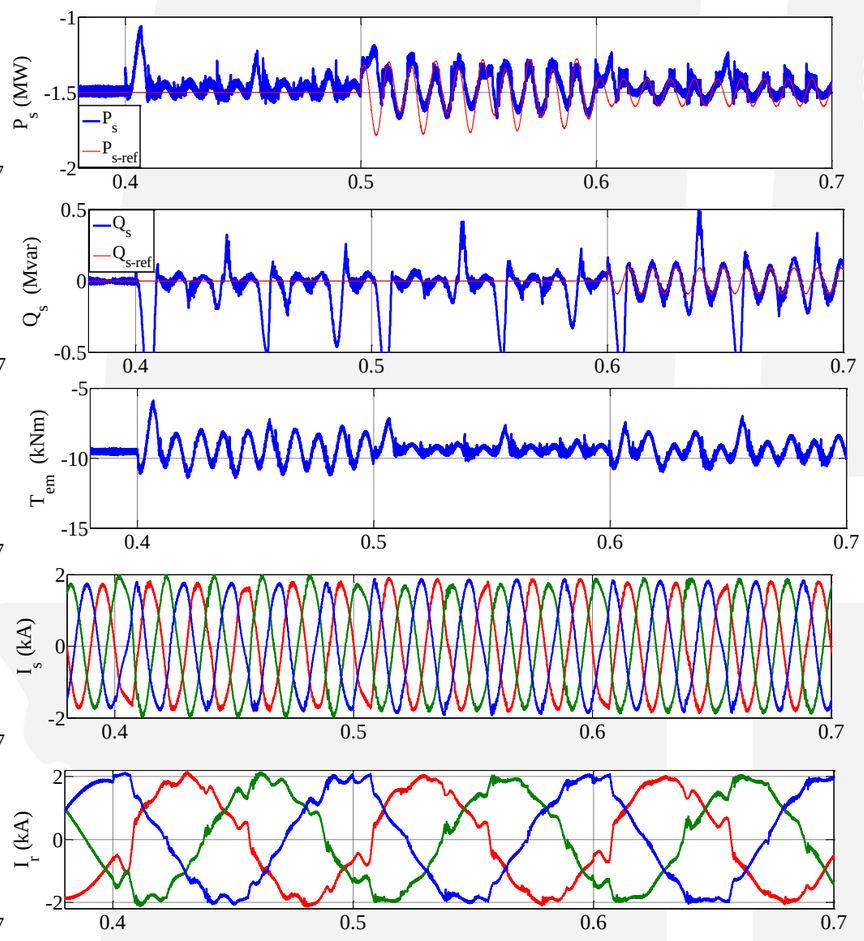


Fig. 4. Result of PC based on three voltage vector during unbalanced grid voltage with three different control targets

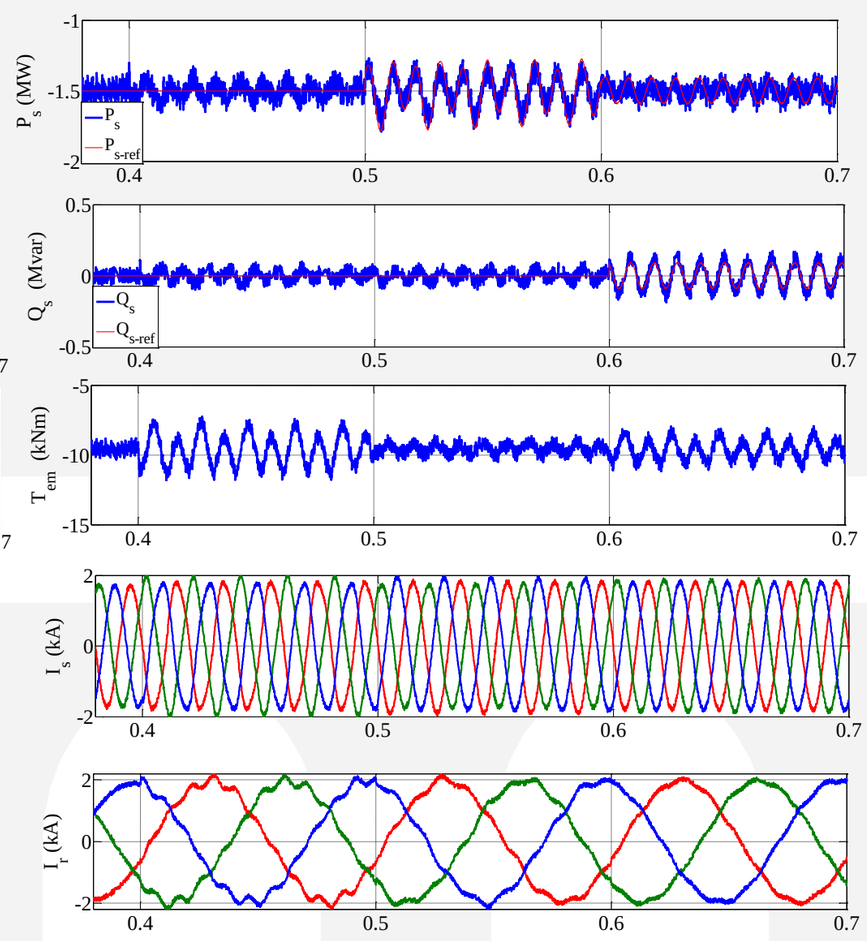


Fig. 5. Result of PC base on only one voltage vector of DFIG during unbalanced grid voltage with three different control targets